

SCIENTIST AT WORK

Benjamin D. Santer

At Hot Center of Debate On Global Warming

By WILLIAM K. STEVENS

DR. BENJAMIN D. SANTER — a shy, even-spoken, 41-year-old American climatologist who climbs mountains, runs marathons and enjoys a reputation for careful and scrupulous work — is the chief author of what may be the most important finding of the decade in atmospheric science: that human activity is probably causing some measure of global climate change, as environmentalists have long assumed and skeptics have long denied.

The finding, issued for the first time in December by a panel of scientists meeting under United Nations sponsorship in Madrid, left open the question of just how large the human impact on climate is. The question is perhaps the hottest and most urgent in climatology today.

Dr. Santer is in the forefront of a rapidly unfolding effort to answer it, and he has been itching to get back to the chase now that he has finished his stint as main author of the crucial chapter 8 of the United Na-

LIVERMORE, Calif.

When science and politics meet, it's hard to find time for work.

tions report, which details where the quest has led so far.

Ordinarily he is so absorbed in the work of analyzing the effects of heat-trapping carbon dioxide and other industrial emissions on climate that he has programmed his computer here in a small, spare room at the Lawrence Livermore National Laboratory to sound a cuckoo-clock alarm every hour. Otherwise, he says, his absorption becomes "catatonic."

Lately, though, he has been able to accomplish little. His role on the U.N. panel, which he did not seek, placed him squarely in the sometimes dangerous intersection of science and politics, provoking so much contention that he has had scarcely a moment to deal with anything else.

Continued on Page C10

At the Hot Center of Debate on the Cause of Global Warming

Continued From Page C1

Instead of plunging back into his research, he has been forced to engage in public combat with a tiny but vocal group of industry lobbyists and contrarian scientists, including Dr. Frederick Seitz, a former president of the National Academy of Sciences and of Rockefeller University. They charge that unauthorized and politically inspired changes were made in chapter 8 after it was approved in Madrid, and that the changes served to underplay uncertainties about the effects of human activities on climate.

Dr. Santer "must presumably take the major responsibility" for "a disturbing corruption of the peer review process," Dr. Seitz wrote in a June 12 op-ed article in *The Wall Street Journal*.

Dr. Santer has struck back hard, like the trim middleweight he resembles, throwing verbal jabs and crosses. He and he alone did indeed alter chapter 8 after the Madrid meeting, he said, because the scientists gathered there accepted the chapter, after long discussion, only on the condition that he do so. The result, he maintains, is a clearer and more accurate statement of the relevant science than the earlier draft. And he points out that the revised chapter devotes a long and detailed section to uncertainties.

The post-Madrid revisions left unchanged the chapter's basic conclu-

sion that the scientific evidence so far points toward a human influence on climate. The chapter, which did not require line-by-line approval, provided the underpinning for the Madrid group's official finding — formally approved word by word — that "the balance of evidence suggests a discernible human influence on global climate." That conclusion, contained in a separate summary for policy makers, also remains unchanged.

The panel advises the world's governments, which are negotiating reductions in greenhouse emissions.

Dr. Santer says that neither his industry critics nor Dr. Seitz contacted him or anyone else associated with chapter 8 for their side of the story, and that by failing to do so, Dr. Seitz "failed to behave as a responsible scientist should." Further, he says, Dr. Seitz, a nuclear physicist who is not a climate expert, is unqualified to judge the science of the case. And he says that his critics have done no peer-reviewed research on the question; that they, not he, are the ones subverting the science and that their charges "would be ludicrous if they were not so serious."

Top officials of the United Nations panel have strongly backed Dr. Santer, calling the accusations "rubbish" and saying that the alterations were faithful to the mandate of the Madrid group. Most governments, including that of the United States, have endorsed the revised report.

Dr. Benjamin D. Santer, chief author of a crucial chapter in a United Nations report on global warming.

Darcy Padilla for The New York Times

And many climate experts have flocked to Dr. Santer's defense.

The criticism "has actually rallied a lot of the serious scientists around him," said Dr. John F. B. Mitchell, a British climatologist who was Dr. Santer's Ph.D. examiner a decade ago. This, says Dr. Mitchell, has been "counterproductive from the standpoint of those trying to weaken the conclusions" of the U.N. report.

The critics have not relented. In Congress, conservative Republican allies of the critics have also weighed in, raising questions about the role of the Department of Energy, which has contracts with Lawrence Livermore, in financing the work of chief authors of the report, including Dr. Santer. This has raised fears among climate scientists of political intimidation.

As for himself, Dr. Santer says, "I've been taken out of science" by having to deal with the attack.

Dr. Santer is widely regarded by colleagues as being among the most careful and thorough of scientists and the straightest of straight arrows, and as being apolitical. "I have no politics," he said. Dr. Karl Taylor, a colleague at Livermore who has worked with him closely, says that

Dr. Santer "has set very high scientific and ethical standards for himself."

Dr. Mitchell said it was "quite ironic that somebody like Ben should be accused of things like this, because I don't think you could find anyone less likely to do that sort of thing."

One of the chief critics says no personal attack on Dr. Santer was intended. "There wasn't any implication that we thought he was doing anything wrong," said John Shlaes, director of the Global Climate Coalition, an industry lobbying group that first raised the questions about chapter 8. Mr. Shlaes complained that the post-Madrid changes in the chapter were not publicly revealed, discussed or formally approved before the report was published. "It was basically the process we were addressing," he said.

Dr. Santer, like his forebears, has been no stranger to the character tests imposed by adversity. Two of his grandparents died in a Nazi concentration camp. His Jewish father fled Nazi Germany and migrated to the United States, where he joined the American Army. He later landed and was wounded at Normandy,

served as an interpreter at the Nuremberg war-crimes trials, met and married his wife in Munich and then became a businessman in Washington, where young Ben was born in 1955. He attended the public schools of Bethesda, Md., moving to Germany at the age of 10 when his father was transferred there.

In Germany, he went to a school for the children of British Army personnel, where, on the first day, the English teacher grabbed his exercise book "and whacked it around my head, and said, 'Santer, we're in a British school, and you'll write in pen, not in pencil.'"

"In the end," Dr. Santer said, "I got an excellent education." He graduated with top honors in 1976 from the University of East Anglia in Britain with a degree in environmental sciences.

To his dismay, his British education availed him little in the job market when he returned to his parents' home, then in the Baltimore area. He bounced around for the next few years, working at various times as a soccer teacher, a German teacher for Berlitz and an assembler in a zipper factory, at which point, he says, he found himself "down and out in Seattle." He made two stabs at a doctorate at East Anglia, abandoning both.

About that same time he nearly died after falling into a crevasse in the French Alps, where some friends had invited him on a mountain-climbing holiday to take his mind off his troubles. He painstakingly worked his way toward "a little blue slit of sky" at the top of the crevasse, and the experience, he says, has "made me realize that there are things much more serious than the present controversy over chapter 8."

He soon made a third attempt to earn a doctorate at East Anglia, which boasts one of the world's top climatology departments, and this time he succeeded.

"I found it fascinating," he said, "the idea that humans could have a potentially large impact on climate." In his dissertation, Dr. Santer used statistical techniques to investigate the accuracy with which computerized models of the climate system simulated regional climates.

He soon moved to another leading climatological laboratory, the Max Planck Institute for Meteorology in Hamburg, where he worked for the first time on the problem of detecting the signal of human-caused climate change, especially global warming — the "greenhouse fingerprint." He also met his wife, Heike, during the Hamburg stint, and they now have a 3-year-old son, Nicholas.

Since moving to Livermore in 1992, Dr. Santer has grappled with the related problems of testing the validity of climate models and searching for the greenhouse fingerprint.

Considerable progress has been made on the fingerprint issue in the last five years. Until recently, most efforts to detect a human impact on climate focused on the average global temperature, which has risen by about one degree Fahrenheit in the last century. But it proved too difficult to tell whether this small amount of worldwide average warming was the result of human activity or of the climate's natural fluctuations. So a small group of researchers, including Dr. Santer, turned to a different strategy.

Behind the rising average global temperature lies a widely varying spatial pattern: some parts of the

world have warmed more than others, and some have actually cooled. The idea of the new strategy was to examine observed patterns of temperature change to see whether they matched the unique patterns expected to result from the combination of growing industrial emissions of heat-trapping gases like carbon dioxide, on one hand, and sulfate aerosols that cool some parts of the planet, on the other. According to this reasoning, the pattern produced by the combination of greenhouse gases and aerosols would be markedly different from that produced by any natural cause.

Dr. Santer likens this approach to that of a doctor looking for the telltale diagnostic pattern of a specific illness to explain a general rise in body temperature.

But how would one know what kind of pattern the greenhouse-gas and aerosol emissions should produce? By using climate models to simulate their effect. In comparing the resulting temperature pattern with the global pattern actually observed, Dr. Santer and other researchers have found that reality corresponds markedly with the model-generated expectations. The correspondence has grown stronger over the years, as would be expected if increasing greenhouse gases were changing the climate. Statistical analysis determined that the correspondence was unlikely to have arisen by chance.

Dr. Santer and some colleagues recently published a paper in the journal *Nature* reporting a similar correspondence when vertical temperature patterns in the atmosphere are analyzed.

These pattern results, when combined with other signs associated with a human influence on climate — a rising sea level, water vapor increases over tropical oceans and more frequent bouts of extreme weather in North America, for instance — are beginning to tell "a coherent story," Dr. Santer said. This emerging portrayal was the basis for the chapter 8 findings.

Already, he says, a number of laboratories are starting to strengthen the pattern studies by including other variables along with temperature — precipitation, for instance, and atmospheric pressure.

Researchers are also beginning to deal with the problem of improving

Charges against a climatologist are termed "rubbish."

the climate models' representation of natural variability, including, for example, changes in solar radiation. The models have been widely criticized for, among other things, failing to adequately represent natural variability. One critic, Dr. Richard S. Lindzen of the Massachusetts Institute of Technology, says the models are so flawed as to be no more reliable than a Ouija board.

"I think that's garbage," said Dr. Santer, part of whose job is to assess how good the models are. "I think models are credible tools and the only tools we have to define what sort of greenhouse signal to look for. It's clear that the ability of models to simulate important features of present-day climate has improved enormously." He says that if the models are right — still a big if — the human imprint on the climate should emerge more clearly in the next few years. All in all, he says, he expects "very rapid" progress in the search for the greenhouse fingerprint.

When might it become clear enough to be widely convincing?

"Even if New York were under six feet of water, there would be people who would still say, 'Well, this is a natural event,'" he said.

Greenhouse critics, he said, would like to "skew the focus of the science totally in the direction of the uncertainties, and they tried like heck to do it in Madrid." Having lost their case on the merits, he said, they are now trying to cast doubt on the science by attacking the scientists and the process by which the United Nations panel reached its conclusions.

Dr. Santer is still not re-engaged in the research he says he loves. But he has recovered enough to say that, contrary to his first reaction, he would now take on the U.N. task again, if asked, when a new climate assessment is made in the year 2000. He would do it, he says, to counter what he believes is a systematic campaign of disinformation.

"My responsibility," he says, "is to do the best job possible explaining the science to people."